US Army Corps of Engineers

DCAF Bulletin

Design Construction Analysis Feedback

No. 97-01 **Issuing Office:** CEMP-CE **Issue Date:** 10 JAN 97 **Exp. Date:** 31 DEC 99

CEMP-C

Subject: Construction Requirements For Seismic Protection For Mechanical, Electrical Equipment

Applicability: Information

Reference: CEGS 13080 Seismic Protection For Mechanical, Electrical Equipment

Purpose: This DCAF Bulletin covers the requirements for seismic protective elements for protection of mechanical and electrical equipment, building piping, conduit, and exterior utilities. It provides an inspection tool in checklist form by system.

Discussion: The following is a set of checklists by system for the construction requirements for seismic protection of mechanical and electrical systems. If you believe that the inclusion of any of the checklist items are not necessary for quality construction, then submit them thru channels on ENG Form 3078 for review. Please share these checklists with your contractor's quality control personnel.

1. Pipes and Ducts Requiring Seismic Restraints
   a. Gas piping 1 inch inside diameter and greater.
   b. Piping in boiler and mechanical rooms 1-1/4 inch inside diameter and greater.
   c. Electrical conduit 2-1/2 inch inside diameter and greater.
   d. All other piping 1-1/2 inch inside diameter and greater.
   e. Rectangular air ducts 4 square feet in cross sectional area and greater and suspended over 12 inches. See h below.
   f. Round air ducts 18 inch diameter and greater and suspended over 12 inches. See h below.
   g. Piping suspended by hangers greater than 12 inches from the top of pipe to bottom of the supporting structural member at hanger attachment and meeting a thru d above. All hangers shall meet the length requirement. If one hanger exceeds the entire run shall be braced. See Figure 1.
   h. Ducts suspended by hangers greater than 12 inches from top of duct to the bottom of the supporting structural member and meeting e or f

above . All hangers shall meet the length requirement. If one hanger exceeds 12 inches the entire run of duct shall be braced. See Figure 2.

2. Bracing and Couplings.
   a. Trapeze type hangers are braced per smallest diameter pipe.
   b. Minimum of two 1/2 inch bolts per hanger brace.
   c. Brace shall not interfere with thermal expansion of pipe.
   d. Braces shall not be attached to two dissimilar structural elements.

3. Anchor Bolts. See Figure 3.
   a. Pad mounted equipment shall use Cast-In- Place anchor bolts.
   b. One or two nuts are required, check specifications.
   c. Bolt size based on equipment weight, see table in specifications.
   d. Four bolts per equipment minimum.
   e. Minimum embedment 12 bolt diameters.
   f. Minimum bolt spacing of 16 bolt diameters.
   g. Minimum edge distance from pad of 12 bolt diameters.

4. Expansion or Chemically Bonded Anchors.
   a. If used shall be tested per ASTM E 488.
   b. Shall be tested in place within 24 hours of installation.
   c. Tested by independent testing agency.
   d. Either Torque Wrench Testing or Pullout Testing.
   e. See specifications for each testing procedure.

5. Sway Braces For Piping.
   a. See specifications for sway bracing spacing.
   b. Two transverse braces minimum for each run*.
   c. One longitudinal brace minimum for each run*.
   d. Branch lines, walls, or floors are not braces.
   e. Longitudinal bracing provided at 40 foot intervals.
   f. Vertical pipe runs braced at 10 foot intervals.
   g. Tubing vertically braced at 4 foot intervals.
   h. Vertical pipe runs brace above center of gravity of pipe span.

6. Sway Braces For Ducts.
   a. Bracing size and spacing in accordance with SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

7. Unbraced Ducts. See Figure 2.
   a. Hangers attached within 12 inches of top of the duct.
   b. Minimum of two #10 sheet metal screws 2 inches from top of duct.
   c. 6 inch minimum clearance to vertical ceiling hanger wires.

8. Emergency Gas Supply Connections For Essential Facilities. See Figure 4.

a. Provide valved and cap connection on gas supply.
b. Located within 12 inches of exterior wall.
c. Clearly labeled with metal sign mounted on wall.
d. Automatic safety gas shut off device in supply pipe.

9. Suspended Equipment.
   a. Sway bracing shall be provided.
   b. Braces shall be secured at both ends 1/2 inch bolts minimum.
   c. Brace length shall conform to specifications.
   d. Braces shall resist horizontal forces (see spec.) weight of equipment.
   e. Details of bracing shall be submitted for approval.

10. Floor or Pad Mounted Equipment. See Figure 5.
    a. Shall be bolted to the floor.
    b. Confirm overturning forces have been addressed in submittal.
    c. Confirm equipment horizontal lateral force has been addressed in submittal.

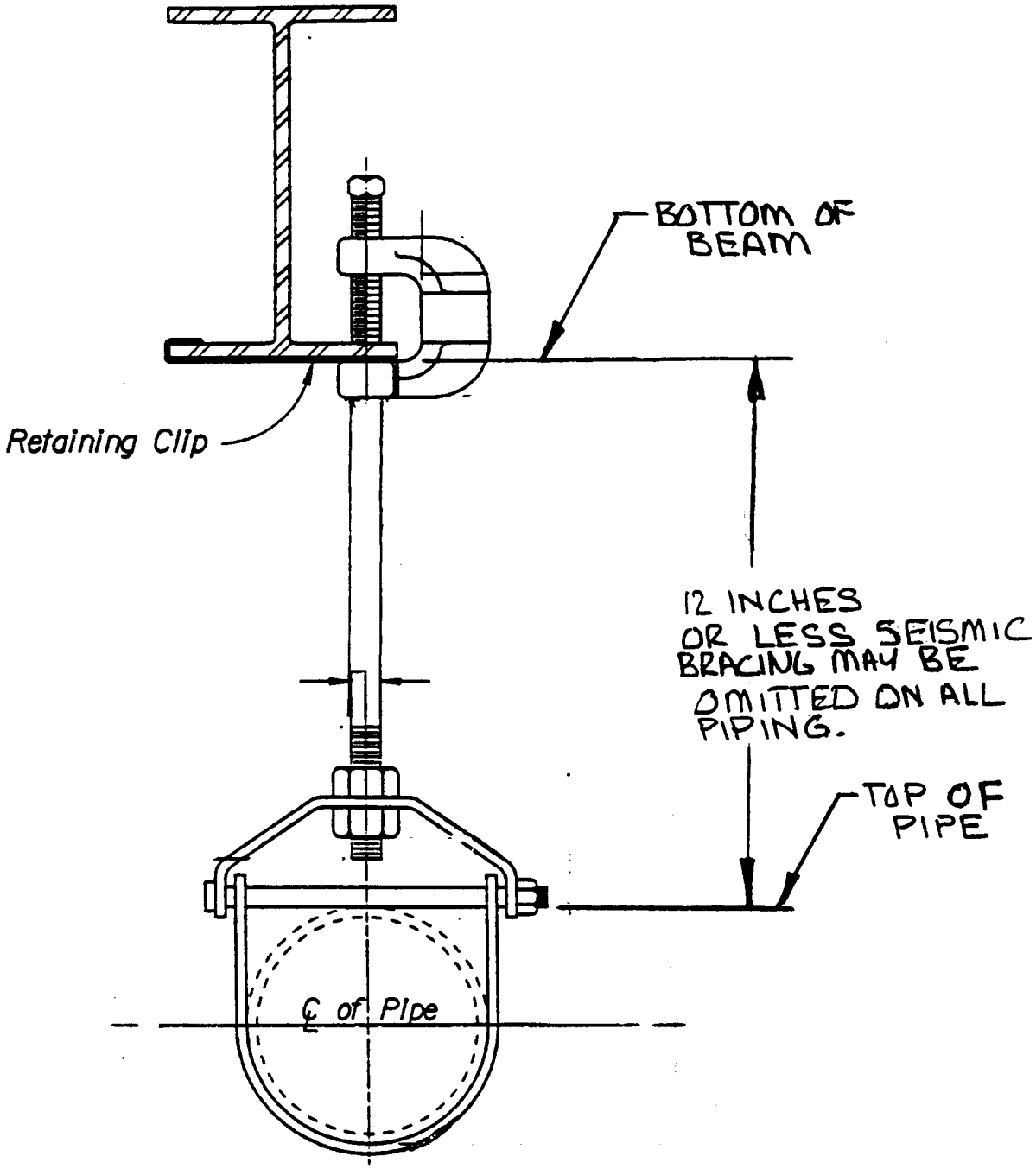
11. Recessed Fluorescent Fixtures.
    a. Supported by seismic-resistant ceiling system.
    b. Fastened at each corner of the fixture to ceiling system.
    c. Fastened with bolts or approved clips.

12. Underground Piping and 4 inch or larger Conduit in Seismic Zones 2,3, and 4. See Figure 6.
    a. Shall have flexible couplings at building entrance.
    b. Couplings shall allow movement between pipe and building.
    c. See specifications for amount of movement.

* A run of pipe is defined as a straight section of pipe that is equal to or greater than the minimum seismic bracing spacing for each pipe size. This definition applies only to seismic protection.

This DCAF Bulletin has been fully coordinated with CEMP-ET. My point of contact is the Construction Evaluation Branch (CEMP-CE) at (202) 761-0205.

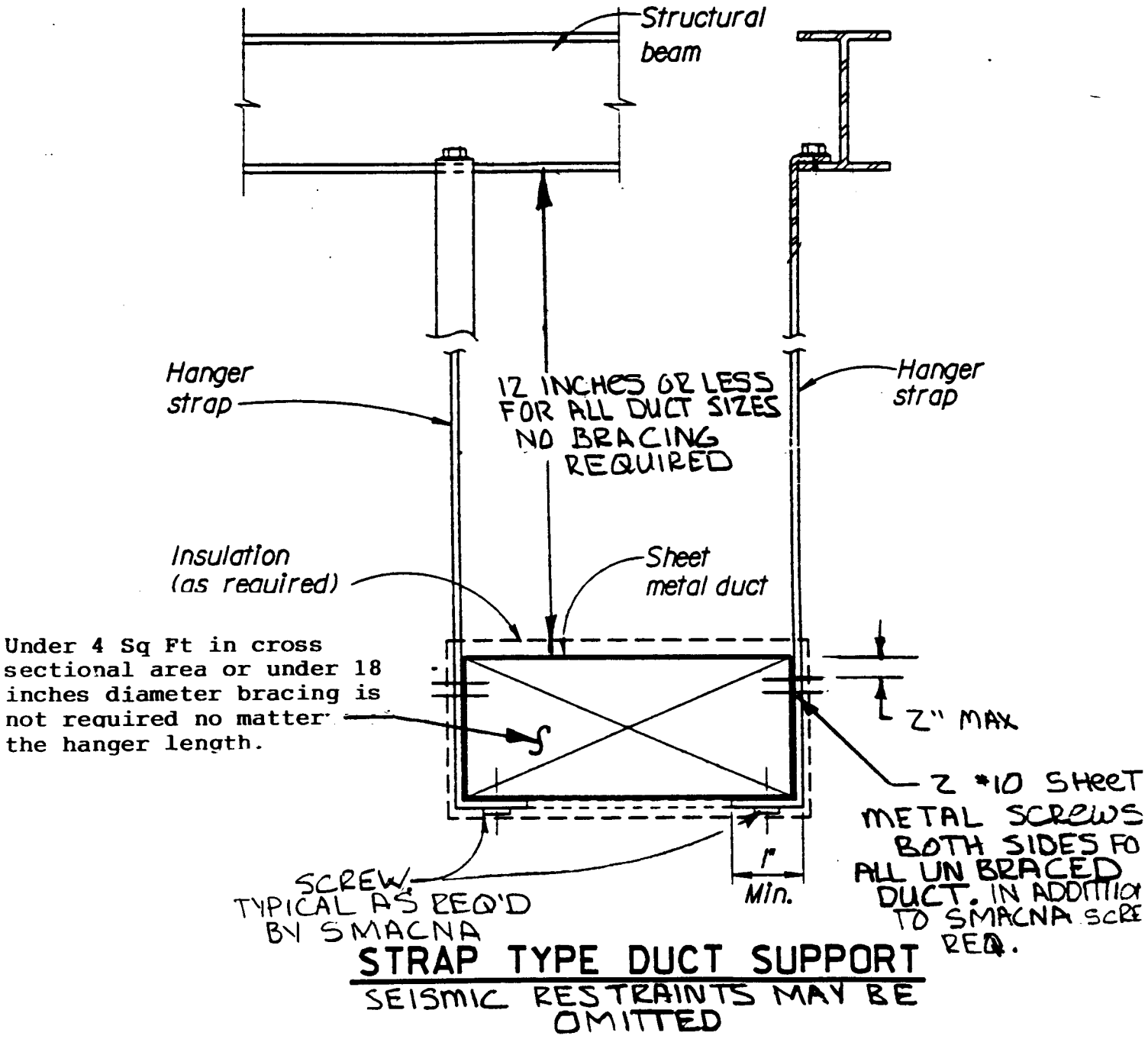
CHARLES R. SCHROER
Chief, Construction Division
Directorate of Military Programs



STANDARD ADJUSTABLE STEEL CLEVIS HANGER

FIGURE 1

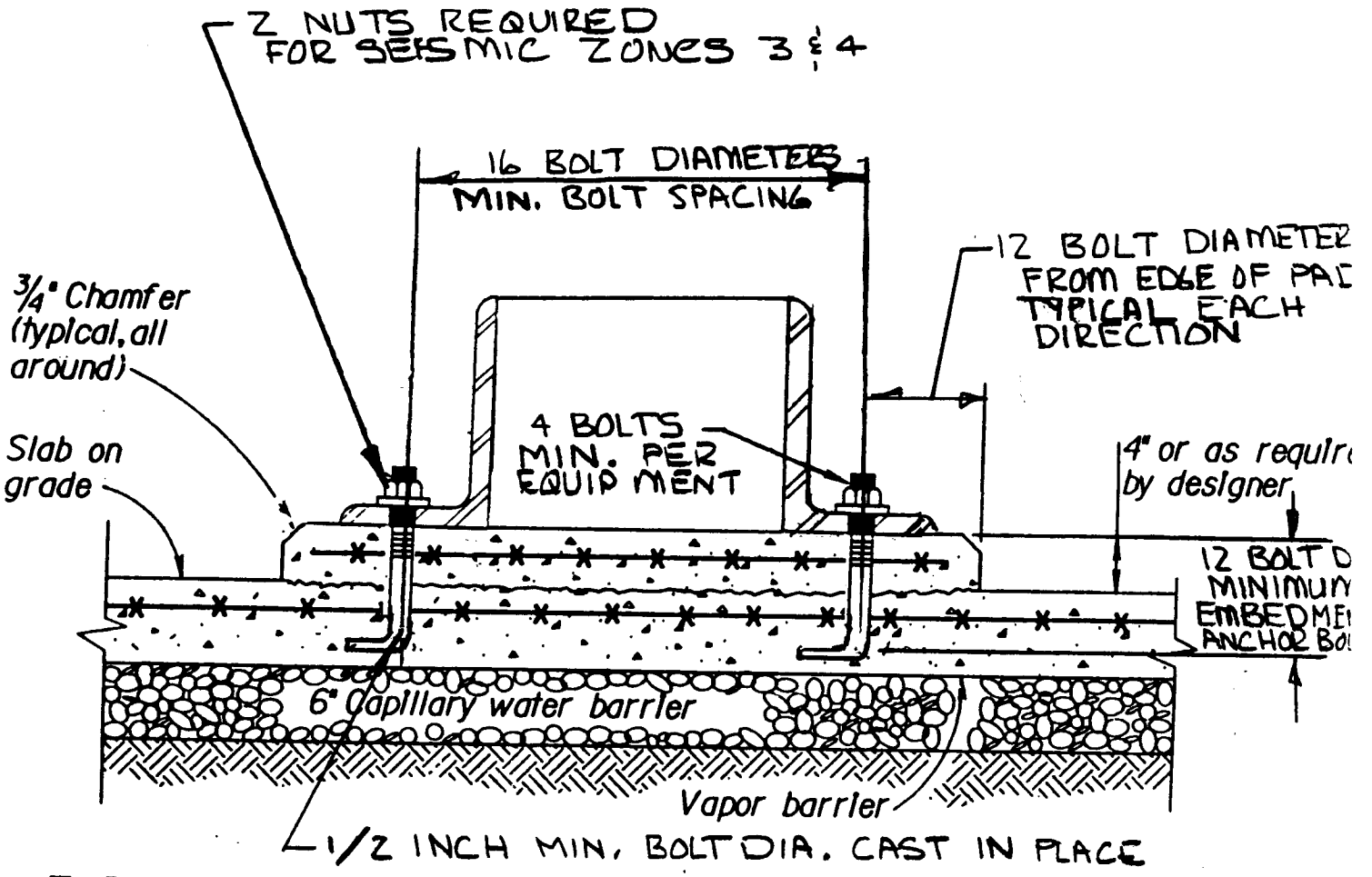
NOTE: 1. If the duct is 4 square feet and greater in area or 18 inches and greater in diameter and any of the strap hangers exceed 12 inches then seismic bracing is required.



STRAP TYPE DUCT SUPPORT

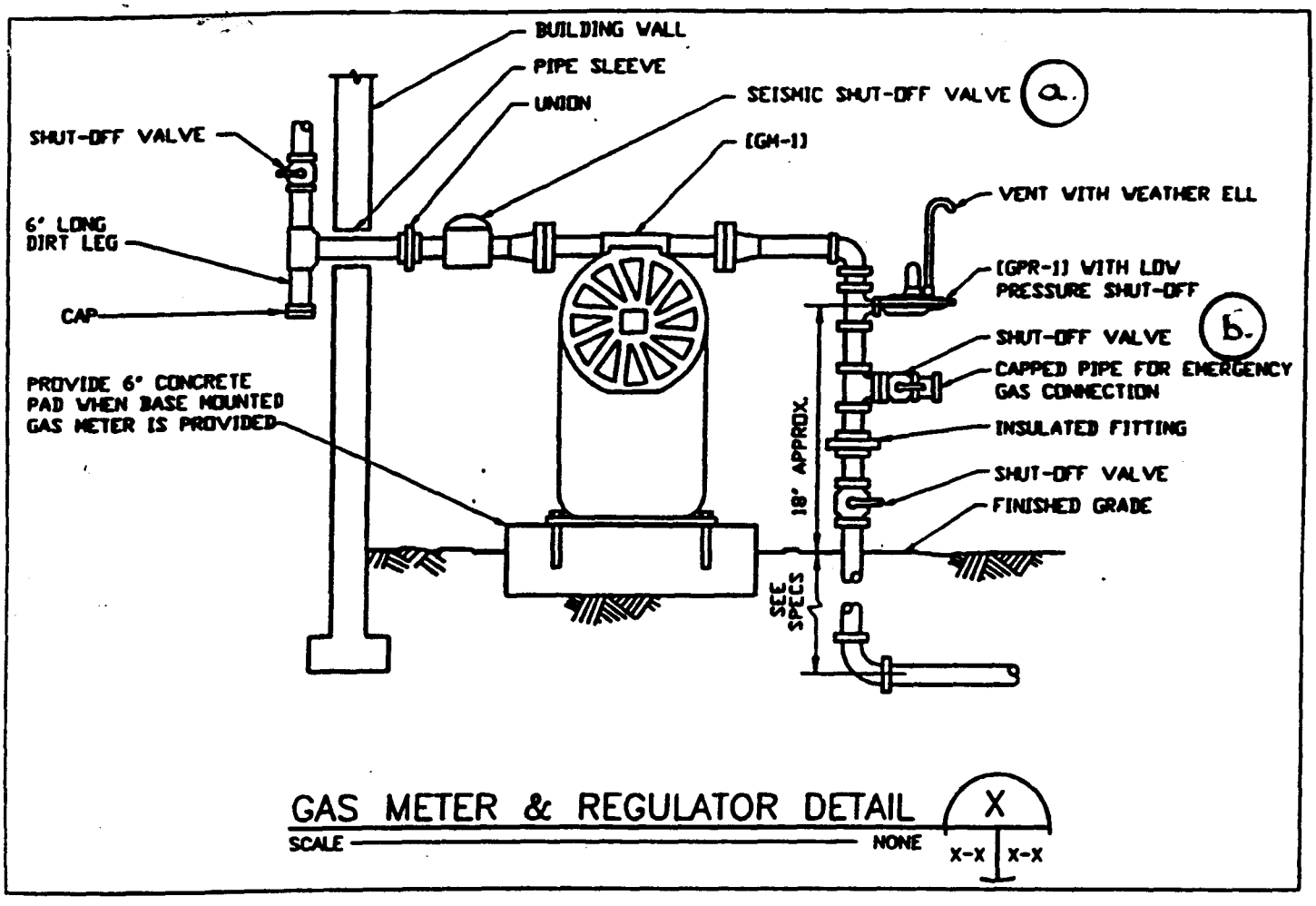
SEISMIC RESTRAINTS MAY BE OMITTED

FIGURE 2



TYPICAL MECHANICAL AND ELECTRICAL EQUIPMENT HOUSEKEEPING PAD DETAIL

FIGURE 3

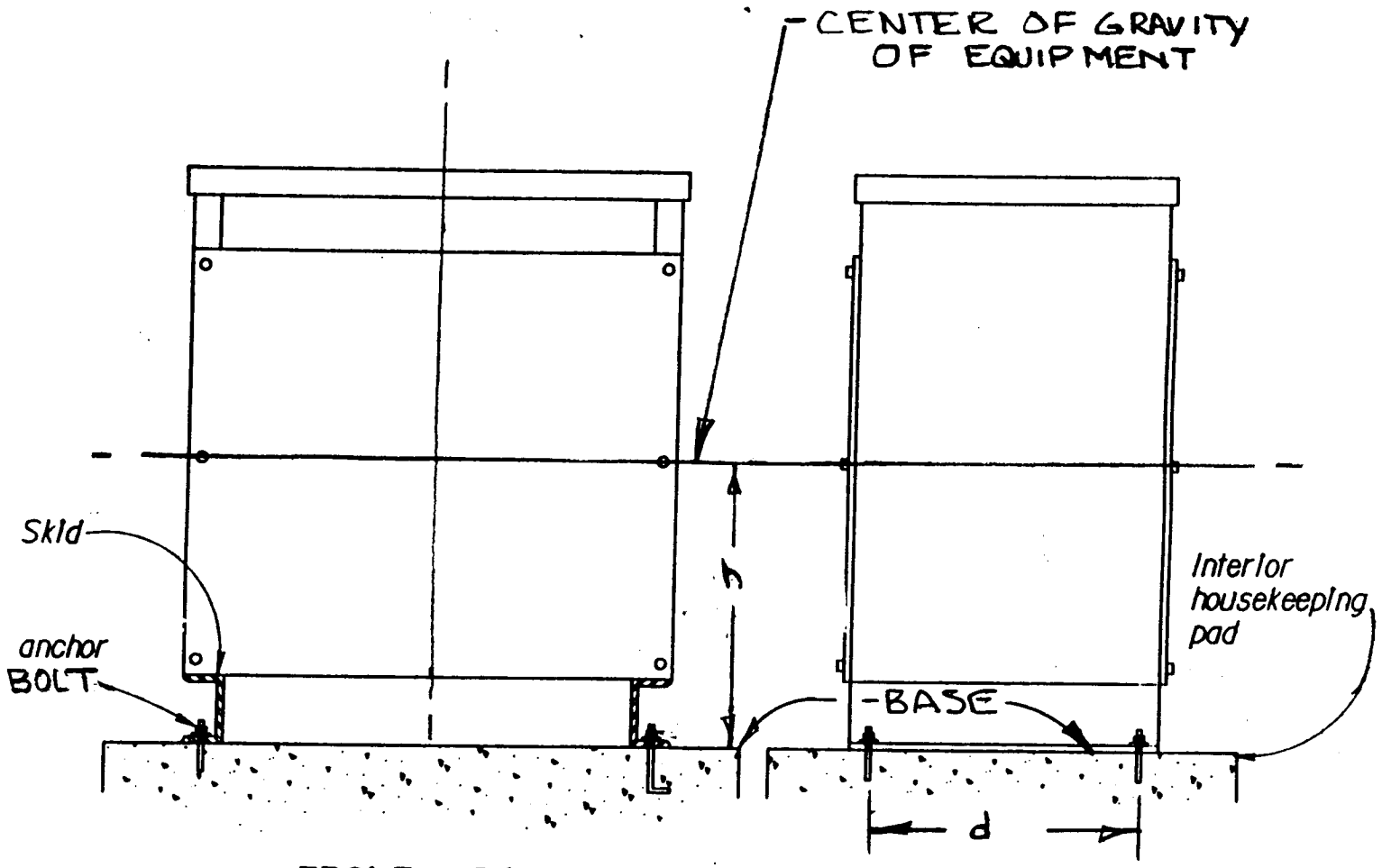


(a) Automatic device to safetly interupt the flow of gas to the building. This required if the facility is essential and in seismic zone 3 or 4.

(b) Provide an aboveground locked, valved and capped emergency gas supply connection. Connection shall be located within 12 inches of the exterior wall and clearly marked with metal sign mounted on wall.

EMERGENCY GAS CONNECTIONS

FIGURE 4



OVERTURNING RESISTANCE OF

PAD MOUNTED ELECTRICAL TRANSFORMER DETAIL

Note: Follow same procedure for other equipment.

h=Height of the center of gravity of the equipment measured from the base to the center of gravity of the equipment.

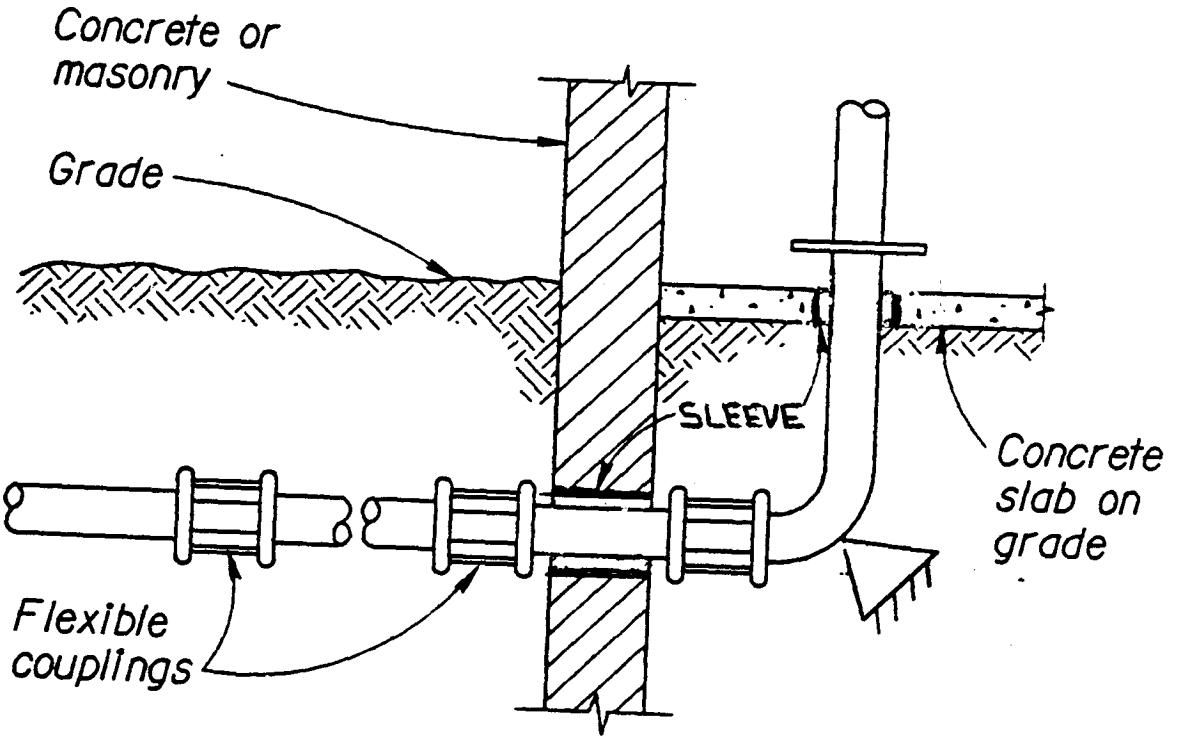
d=The minimum distance between anchor bolts. Same units as h.

If this ratio is greater than ratios in table below the bolt values in paragraph Minimum Bolt Sizes, Cast-In-Place Anchor Bolts shall not be used and calculations shall be provided to verify the adequacy of the anchor bolts for combined shear and overturning.

Zone	h/d Ratio
1	8.89
2A	4.44
2B	3.33
3	2.22
4	1.67

Ratio h/d may vary check specifications for correct ratio.

FIGURE 5



SEISMIC DETAIL FOR PIPE ENTERING BUILDING

NOTE: Underground piping and 4 inch or larger conduit, except heat distribution system, shall have flexible couplings installed where the piping enters the building.

FIGURE 6